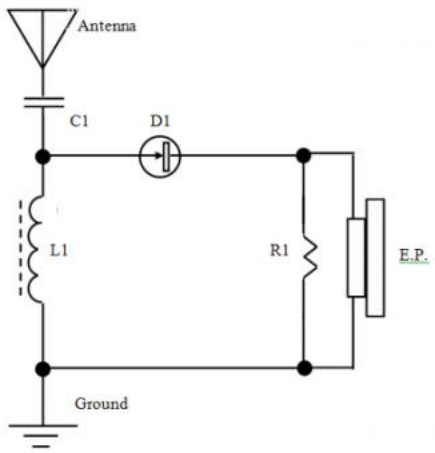
CIRCUIT WIRING DIAGRAMS

THE NIC NAC TIC TAC CRYSTAL RADIO SET

MARCH 21, 2015 / BY CIRCUIT WIRING / IN RF RADIO CIRCUITS



Warning: this kit contains small parts that may
form a choking hazard, and is not suitable for children under 5 years old.

Introduction

Crystal radios have been around for over 100 years and exist in many different shapes, sizes and complexities. Some are definitely better than others, but wired correctly and connected to a good Antenna and Ground wire system, this simple little AM radio receiver should pull in at least one strong local radio signal for you to listen in to. In diagram 1 you can see the basic layout of the 'crystal set'. They are called crystal sets, as the original designs used a special material called galena or pyrite, as the detector element, which picks out the sound wave from the radio wave. These crystals have been replaced with a modern component called a diode, and we'll get to use one of those as we put this kit together.

How it works

Signals from your local AM radio stations are traveling through the atmosphere at the speed of light, and they pass through just about everything. These signals hit your antenna wire and induce a small signal current that flows down into the radio's tuned circuit, and out through the ground wire, to Earth. The coil, L1 and fixed capacitor, C1, form the 'tuned circuit' in our project, in conjunction with the antenna/ground wire system, which enables the receiver to select one station's frequency and reject the rest. This may seem like a limitation on the radio, but once you've got this simple receiver going, you can add one or two more parts in order to make a 'tunable' version that can tune across part or all of the AM radio band, for just a couple of dollars more. All you have to do is swap several parts of differing values around, (included in your kit,) until you receive a reasonably strong local AM radio station! Experimenting is half of the fun with these circuits.

The frequency selected by this process is comprised of two parts – the 'carrier wave' which is the radio station's fixed frequency (its 'spot' on the dial of a transistor radio set) and the 'program signal' which is the voice, music, secret sound, which originates inside the radio station's studio. This is the signal that we want, and the next component, the diode, D1, enables the sound or audio signal, to be split away from the carrier wave. This is called the 'detector' because it detects the sound signals contained inside the carrier wave.

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pietzo or crystal earphones, as these devices need a direct path to ground for them to work properly and not distort the signal.

Resonance

At a chosen frequency a special effect called "resonance" occurs. This simply means that when the coil and capacitor working together as the 'tuned circuit' have received the one particular frequency they were set for, then maximum power transfer from transmitter to receiver will occur. All other radio station's signals will be fed out to earth by the ground wire, and the one you want will be playing away in the earphone. Our earphone has a special material called 'pietzo crystal' and when a small signal is fed into the crystal via the diode and link wire, the crystal will actually vibrate in unison with the signal. This crystal is flat and round, and is attached to a larger piece of tinfoil, which vibrates too, reproducing sound waves that we can hear.

Diagram 1 Tic Tac Radio Circuit Diagram

In the diagram at left, you can see the circuit for our simple AM band crystal radio set. It has just four components – a capacitor, C1 which together with the next component, the inductor L1, which stores radio energy and helps tune the radio to one station. Thirdly, there's the diode D1, which separates the program signal (the voice, music, secret sound) from the radio station's transmitting frequency, and finally, the resistor R1, which forms a signal return path to ground and provides stability for the crystal earphone, EP, which changes the electrical signal coming out of diode D1, into sound waves which we can hear.

Parts Identification And Layout

The orange or blue coloured fixed capacitor is made of ceramic material, and consists of two small metallic plates, separated by the ceramic material. These two plates store an electrical energy charge between them, and allow RF (Radio Frequency) energy to pass through. Small ceramic caps are measured in picofarads (pF). The coil or inductor, is a larger cylinder shaped device, with coloured bands to indicate its value in micro henries (uH). The diode is a small signal type (BAT 46) and is made of a special material called silicon. This material allows the sound or audio signals to pass through to the earphone, but prevents the carrier wave from getting through. Finally, the crystal earphone is connected across the resistor, which is measured in ohms. This resistor (a 100K one, marked brown/black/yellow) provides stability for the earphone, by siphoning off some of the detected signal, and feeding it directly to the ground, via the ground wire.

Building The Radio Receiver

Take your parts from the packaging, and lay them out on the work area. Take the printed overlay template supplied with your kit, and peel off the protective backing, leaving the 'sticky stuff' exposed. Lay it on top of the small plastic oblong shaped base, aligning the edges together, and press the overlay onto the plastic. Take a sharp metal object (small jeweler's screwdriver, large pin or needle,) and make five holes in the material where you see a large dot. These dots are connection points where you will push the wires from each component part through and when they are all in place, you will then gently twist them together, forming a basic join. First, place the legs of capacitor C1 through holes 1 & 2. then take the coil, L1 and push its legs through holes 2 and 5. Take the diode and push its legs through holes 2 & 3, and finally take the resistor R1, and push its legs through holes 3 & 4. Take the short piece of link wire and push its legs through holes 4 & 5.

Building The Radio Receiver

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overlay onto the plastic. Take a sharp metal object (small jeweler's screwdriver, large pin or needle,) and make five holes in the material where you see a large dot. These dots are connection points where you will push the wires from each component part through and when they are all in place, you will then gently twist them together, forming a basic join. First, place the legs of capacitor C1 through holes 1 & 2. then take the coil, L1 and push its legs through holes 2 and 5. Take the diode and push its legs through holes 2 & 3, and finally take the resistor R1, and push its legs through holes 3 & 4. Take the short piece of link wire and push its legs through holes 4 & 5.

When all four components and the link wire are mounted on the base, in accordance with the overlay, you can then make the joins by twisting the wire ends poking through each of the holes, together until they become tight. Bend them up out of the way, and make sure that none of the wires from one join are touching other joins. Finally, take the earphone and cut the 3.5mm plug off the end, carefully strip the insulation off each wire using a pocket knife or side cutters, and then twist the wires around the legs of the resistor, R1.

Attach your Antenna and Ground wires, and begin to test out your "Nic Nac Tic Tac" crystal radio.

Once you've finished testing the radio receiver, and have successfully received at least one local radio station, you can then fit the whole base with components attached into the Tic Tac box. Punch holes in the lid for the antenna and ground wire connections, and a larger one in the other end, for the earphone wires to protrude through.

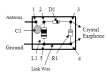
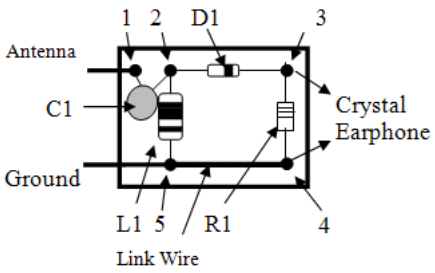
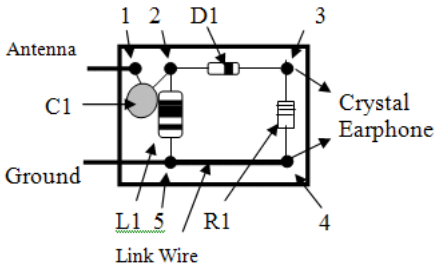


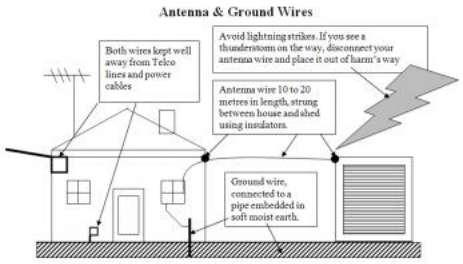
Diagram 2 Tic Tac components layout

Mount the parts on the plastic base by Carefully use a small sharp tool, such as a jeweler's screwdriver, to make the five holes in the base. Then insert the wires from each component through the appropriate holes, and then gently but firmly twist each group of wires up and underneath the base. Make sure that you insert the earphone wires in the hole in the back of the Tic Tac box before you strip the plastic insulation off each wire. Then tie a small knot in the wire, leaving about 2 cm, and attach the bared ends those wires to either end of resistor R1, before enclosing the whole assembly inside the Tic Tac box.





These two diagrams act as an overlay, so that you can place them on top of your plastic base and use them as a guide for component holes and wiring



Erecting Antenna And Ground Wires

that you can obtain.

The Antenna Wire

The antenna wire needs to be reasonably long, and as high as you can safely place it. At least 10 to 20 metres in length and around 2 to 3 metres in height as a minimum, taking into account any power cables or telephone lines in the vicinity. Metal objects such as poles or frames or other similar structures can often 'ground' radio signals, preventing them from reaching your antenna wire, so you need it to be in as much open space as possible. Alternatively, you may be able to attach a short lead to a metal frame or structure (taking into account your electrical safety, which is YOUR responsibility,) that is insulated from ground potential, and any other voltages or currents, besides radio waves.

If you have any doubts about the electrical safety of your antenna wire installation, consult a qualified electrician, or other similarly qualified person, and remember, DO NOT erect antenna wires near to electrical power or telephone cables or other structures of a dangerous nature – check it out first!

Ground Wires

Ground wires are just as important as antenna wires, as they form part of the same 'front end' tuned circuit, completing the circuit to ground. Radio stations transmit their signals through the atmosphere, but they also travel along the ground and just underneath I – these are called 'ground waves' and the ground wire helps to capture them. It also gets rid of unwanted carrier waves that have not been selected by the tuned circuit and its preselected values for coil and capacitor. The best way to make a solid ground connection, is to find a cold water tap or pipe with no attached electrical ground wire system added to it, and bare your ground wire and wrap about five or six turns of bared copper wire onto the pipe, and then twist the end of it around the rest, securing it to the pipe. Use a metal clamp or bracket, if you think that is warranted to give you a firmer connection.

Ground wires are best connected to either a properly installed ground stake (embedded up to a metre in moist earth) or taken directly to cold water pipes or backyard taps, that have NO CONNECTION to any of the building's mains electrical earth wiring. DO NOT use gas pipes or hot water pipes, as these installations DO NOT go to an electrical ground, and connecting your ground wire to them may result in shocks or other unpleasant side effects. Connect ground wires to a safe and independent electrical ground connection. Once again, if you have ANY DOUBTS about the safety of a ground wire installation, consult a qualified electrical parson to ensure that your installation is safe. AH 2009

Hints & Tips On Getting The Tic Tac Radio Going

Having problems getting a radio signal? Or are you getting a signal with lots of noise, hum, clicks and pops in the earphone? Not able to string up a conventional antenna or ground wire system? This section is devoted to helping you get the most out of your crystal radio project. Most people will be able to erect an antenna or ground wire system either in their back yards, or in a nearby park or waterfront area. Some people live in dense housing lots or unit blocks, and it can seem impossible to do the necessary things in terms of establishing your antenna/ground system.

There are alternatives to the conventional arrangements, such as using the cold water pipes under your kitchen sink or bathroom vanity. Using parts of you metal balcony barrier/fence. These can provide useful levels of signal for simple radio reception. Make sure though, that none of your cold water pipes double up as a path to ground for any 240 volt mains wiring, as using this as a ground can be risky.

If you end up with a relatively short antenna you may find that you are getting a signal or sorts, but it's not loud enough to be satisfied with that level of sound, as a good result. You can use an extra component called a 'variable capacitor' between your antenna lead in wire, and the crystal set itself, to help 'tune in' the antenna. With simple crystal type receivers, it's important to be able to 'match' the antenna to the set, particularly if the antenna ends up being a short wire one (one that is less than 10 or fifteen metres in length, and 2 metres above the ground or less).

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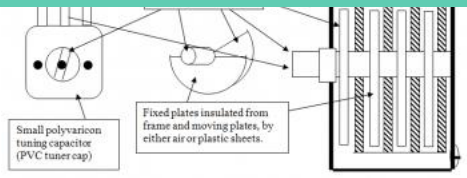

In the diagram above, you can see two different types of variable capacitor. Although the materials, construction and size are different, the principle of operation is the same. The insulation between the plates can either be air (the atmosphere) or plastic materials, such as Mylar. The polyvaricon shown on the left is a miniature plastic tuning capacitor, found in most modern pocket transistor radios. The larger one shown on the right, is made almost entirely of metal, and uses air as an insulator between the fixed and moving plates, and phenolic material to keep the fixed plates positioned correctly on the metal frame, without actually touching it. The idea, is to interpose the variable capacitor between your antenna wire, and the set, and then "tune in" the antenna. Don't forget that you've been given a set of parts, which includes three ceramic (fixed) capacitors and two mini inductor coils. If you can't get a station with one set of coil and capacitor, try swapping them around until you get one talking or playing music in your earphone.

A Word On Crystal Earphones

You will have been supplied a small pietzo crystal earphone as part of your kit of parts. These generally speaking give good sound reproduction, but occasionally they can drop out. Odd ones are not very good at all and need replacing. It is the way they are made at the factory, and also how they are stored and handled. Sometimes dropping them onto a hard floor surface can cause the connections inside the earphone to work intermittently. To fix them up and get them going again, try blowing down the small earpiece several times, each time listening to see if full sound has been restored. If this doesn't work, then try tapping them on the palm of your hand several times, each time listening to test the sound. If you need more help with this kit, you can contact us, or go onto the Internet, and try websites like www.midnightscience.com or www.theradioboard.com or just Google the words "crystal radio set" and see what happens!

AH 2009

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No related diagrams.

FM TRANSMITTER DIAGRAM

MINIATURE FM TRANSMITTER #1

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CIRCUIT WIRING SEARCH

Audio battery chevrolet Cigar Lighter circuit Circuit Diagram circuit diagrams Electrical Circuit electrical diagram Electrical Schematic Electrical System Electronic C ford fuel pump Fuel Pump Relay Fuse Block Fuse Box Fuse Holder fuse layout fuse map Fuse Panel Headlamp Horn Horn Relay ignition coil Ignition Switch Instrument Cluster power Power Supply Power window Radio Relay Schematic Circuit Schematic Diagram schematic diagrams Starter Relay Studebaker wiring wiring connection Wiring Diagram wiring diagrams Wiring Harnes wiring schematic wiring system wiring work